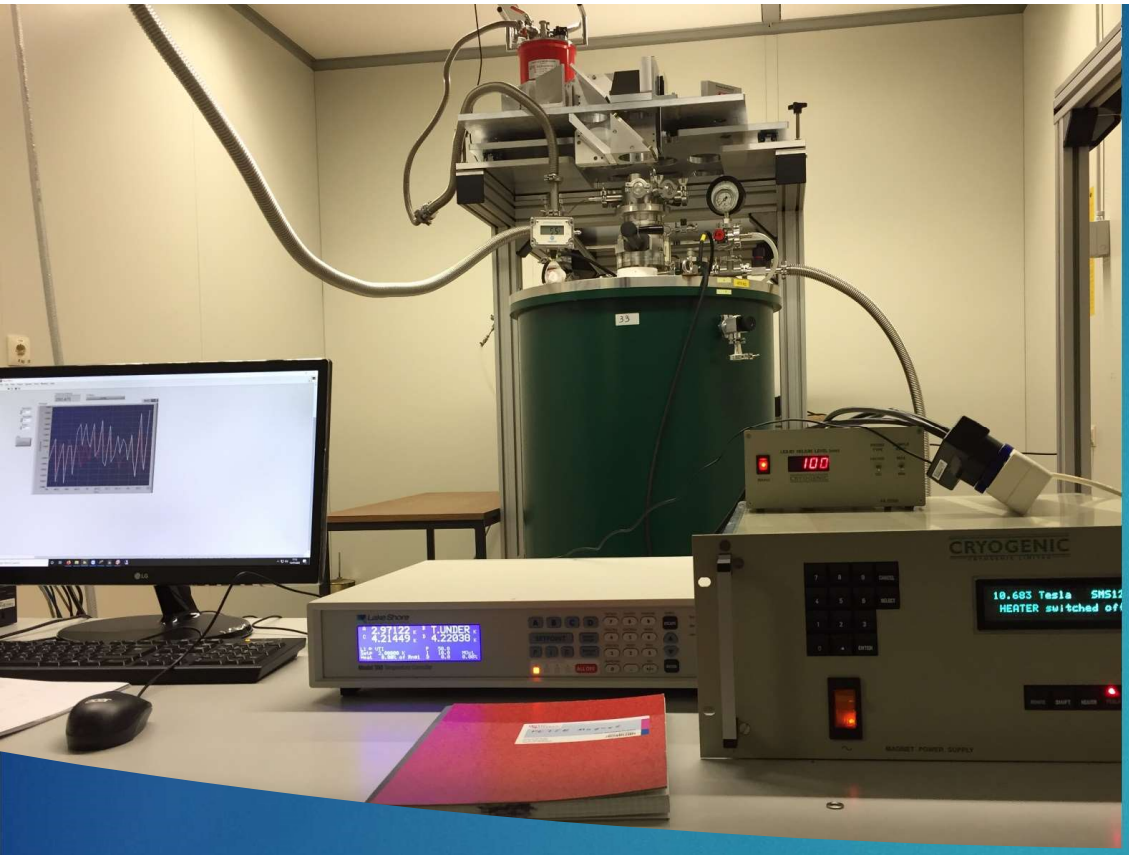

PETER – sensitivity and accuracy combined

Božena Čechalová (Brno University of Technology)

MARCH 4, 2020

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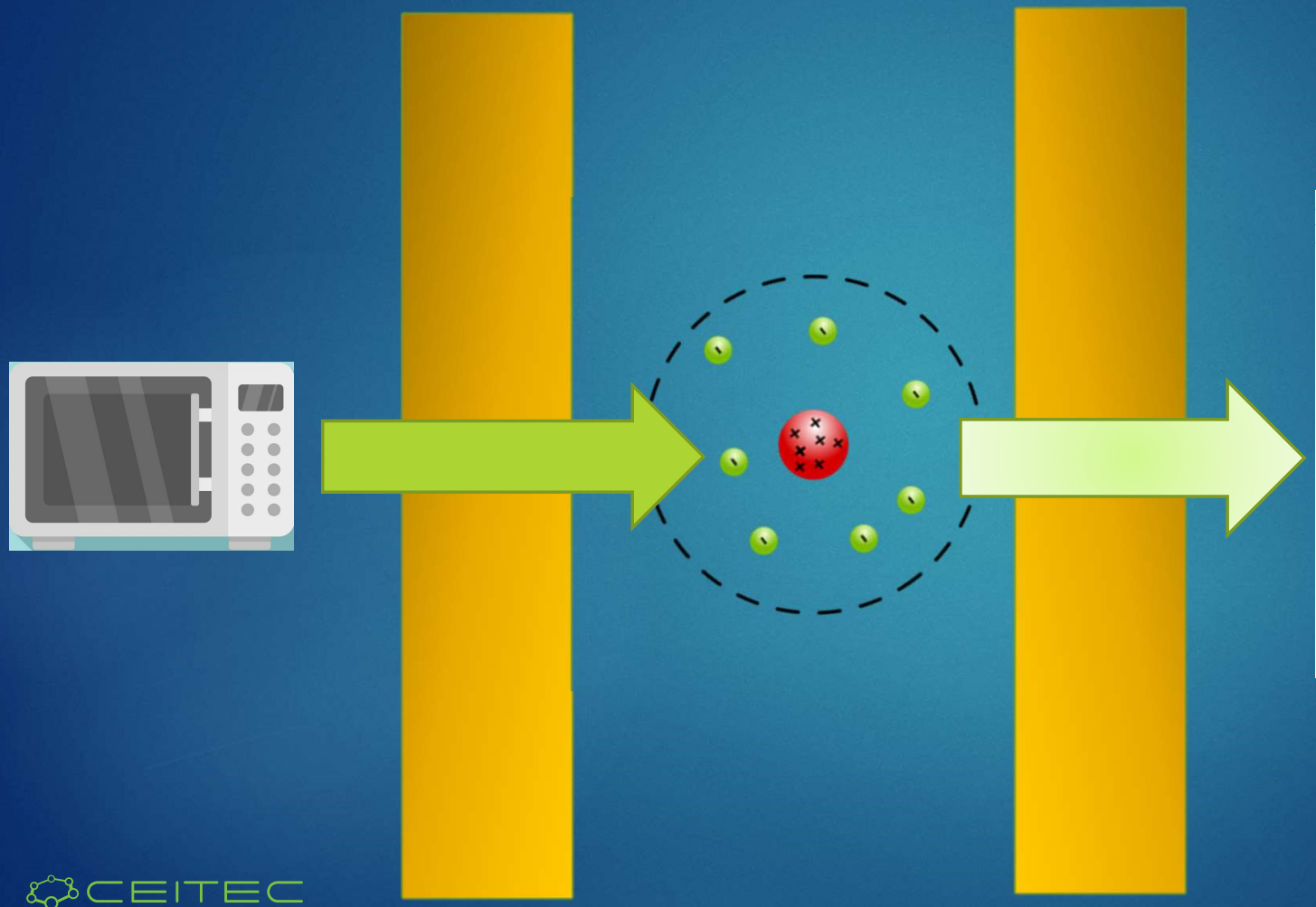
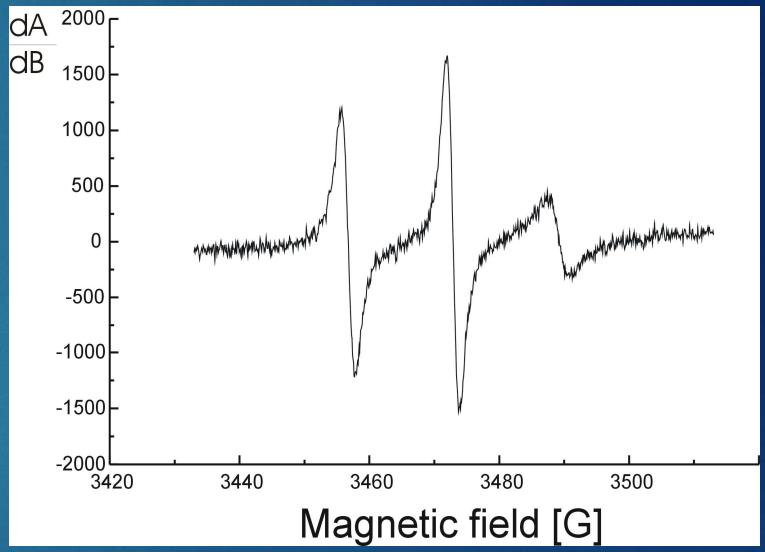
PETER – Horizon 2020 FET-OPEN GA767227

What is Electron Paramagnetic Resonance?

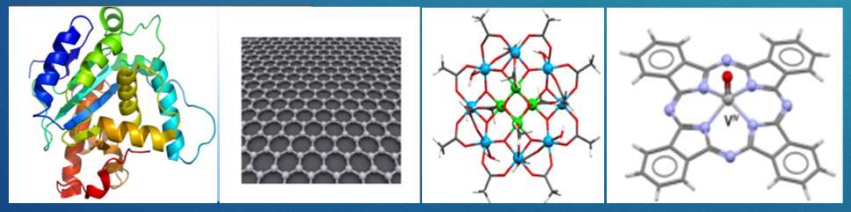




Classic Electron Paramagnetic Resonance

Selective to unpaired electrons – defects, charge carriers, biomarkers, etc.

This technique looks "inside" the sample, without destroying it.



Classic EPR has low sensitivity (requires high number of detectable spins).

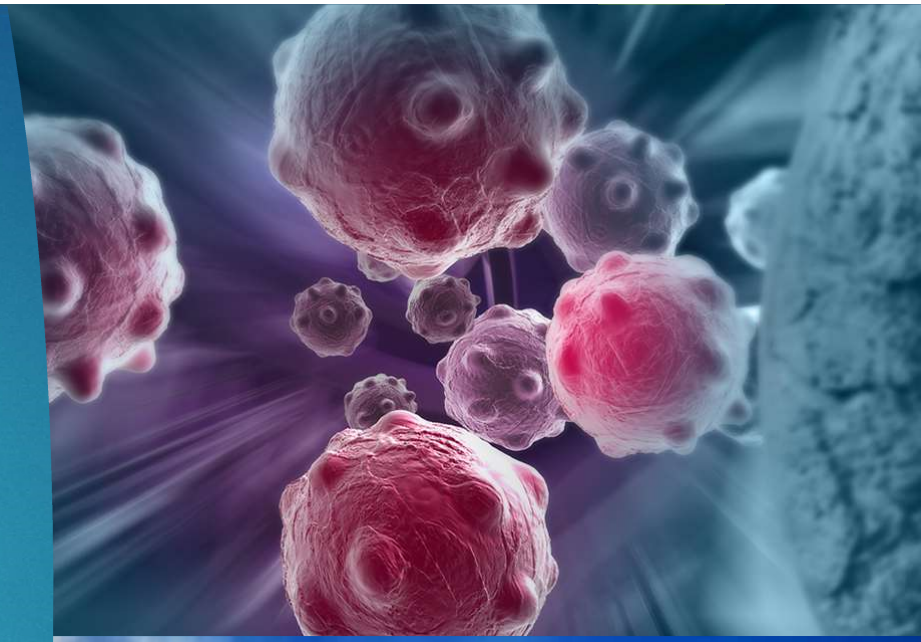
Unsuitable for low-spin density materials.

Unsuitable for heterogenous-surface samples.

PETER Solution

Higher spectral resolution

- distinction of different species → **in-cell EPR** (tumor diagnostics)
- investigation of origins of failure of batteries → **enhancement of battery lifetime**



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PETER Solution

Enhanced sensitivity

- improvement in research of charge carrier properties → research of organic and inorganic **solar cells**
- investigation of molecular nanomagnets → emerging **quantum technologies**

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How do we do it?

- Combine advantages of High-Frequency Electron Paramagnetic Resonance (HFEPR) with Scanning Probe Microscopy.
- In systems with structure on the microscale, spectroscopic microscopy allows investigation of individual components.
- Plasmonic effect:
  - Common in electric-field spectroscopy techniques (SERS, TERS)
  - FIRST TIME in EPR with PETER
  - Enabling scanning probe microscopy regime

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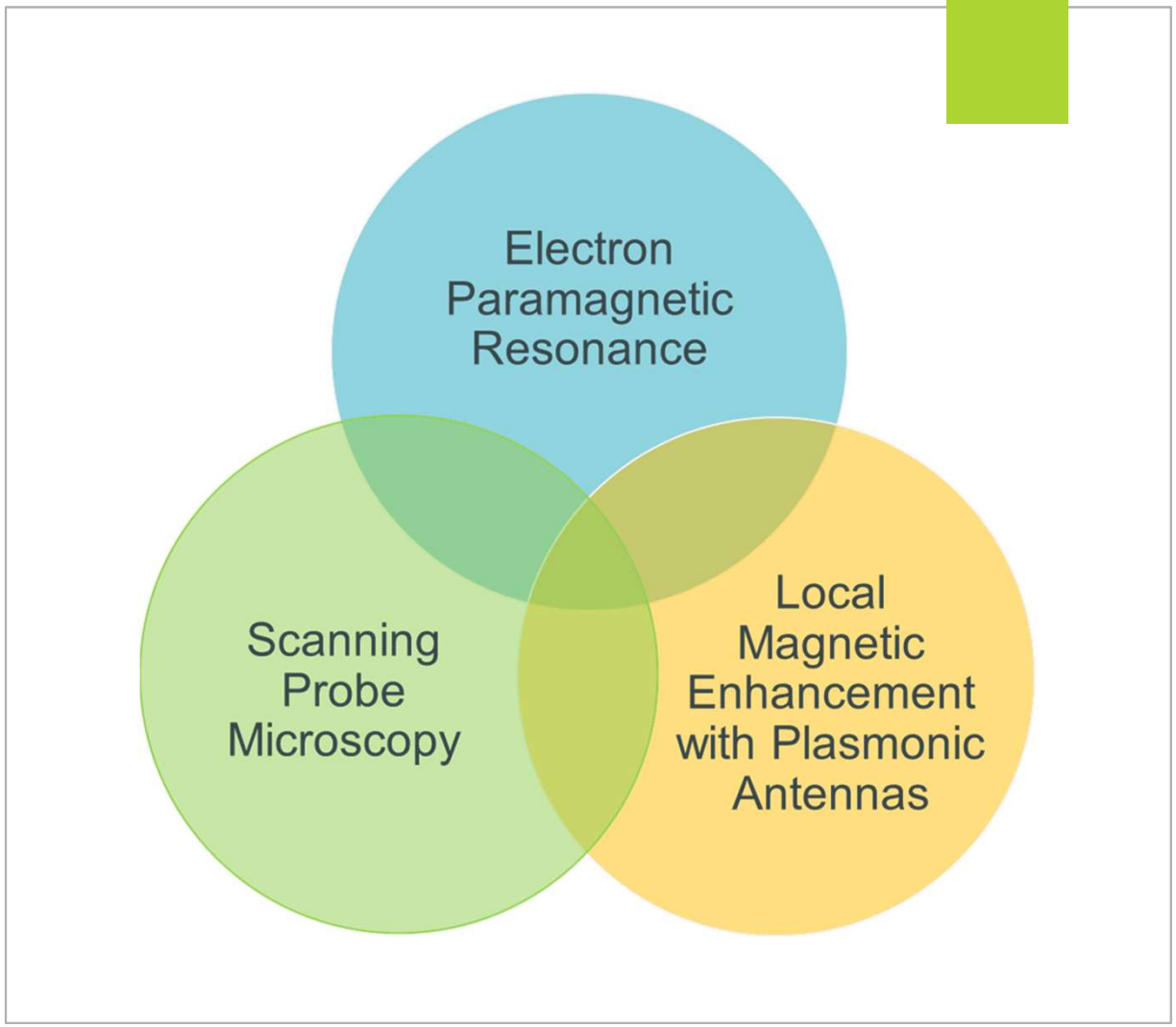
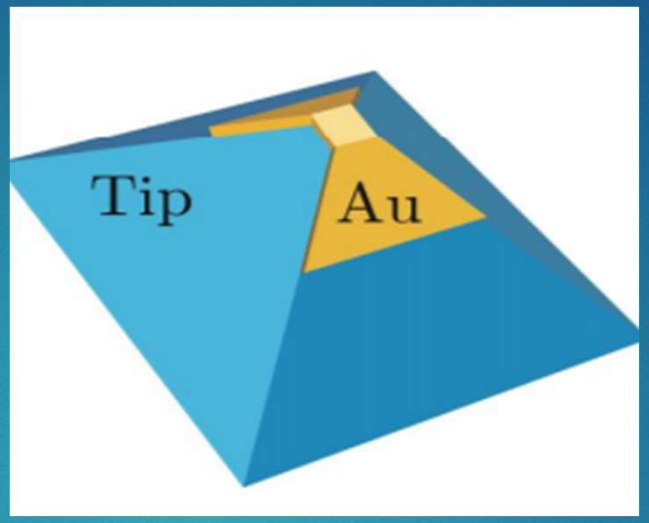
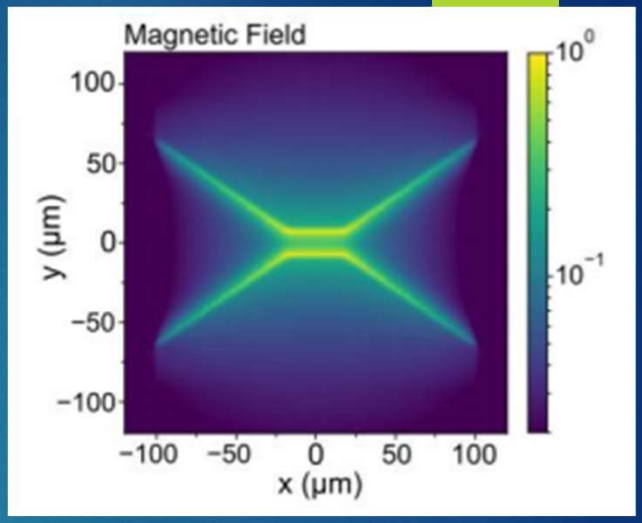
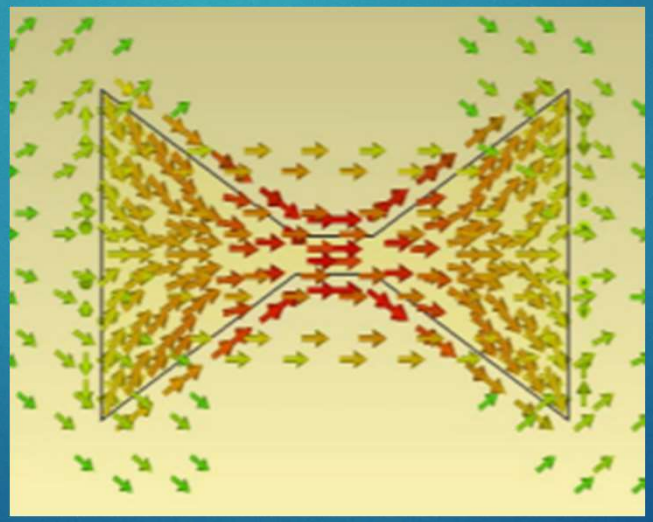


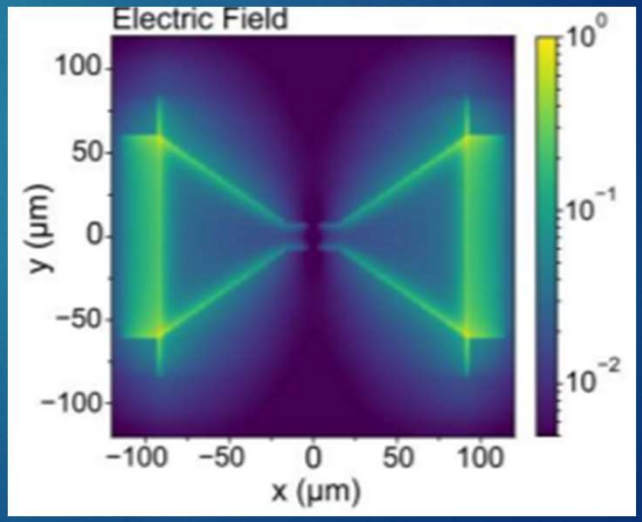
Why plasmonic effect?

- Electron paramagnetic resonances are magnetic dipole transitions.
- Magnetic dipole transitions are much weaker than electric dipole transitions.
- Resonant structures are used to enhance the radiation magnetic field strength.









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PETER – partners and roles

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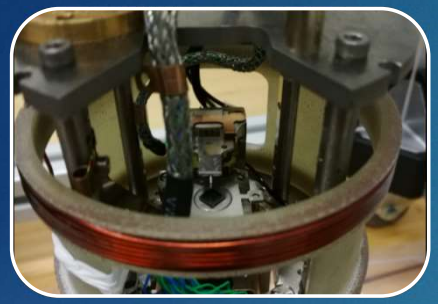
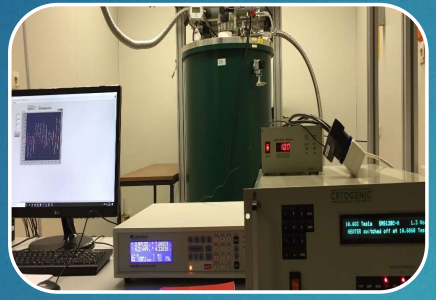


SPM setup
Test samples

University Stuttgart



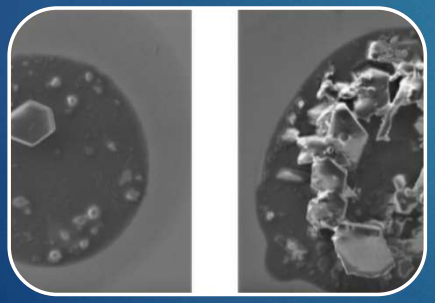
Prototype testing

CIC NanoGUNE

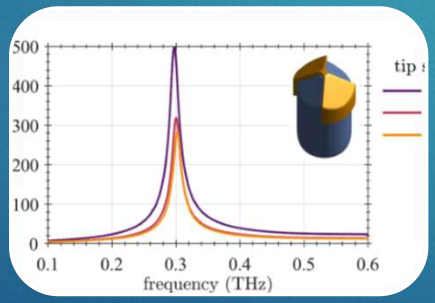
SPM probes

Thomas Keating Ltd.

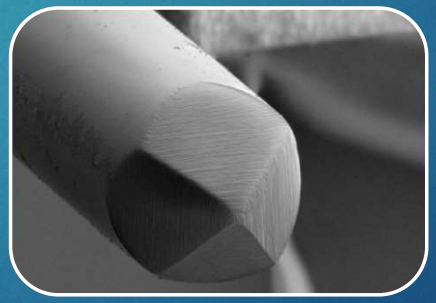
THz quasi-optics



PE EPR theory



PE EPR experiments



Probes fabrication and testing

Modulation coils

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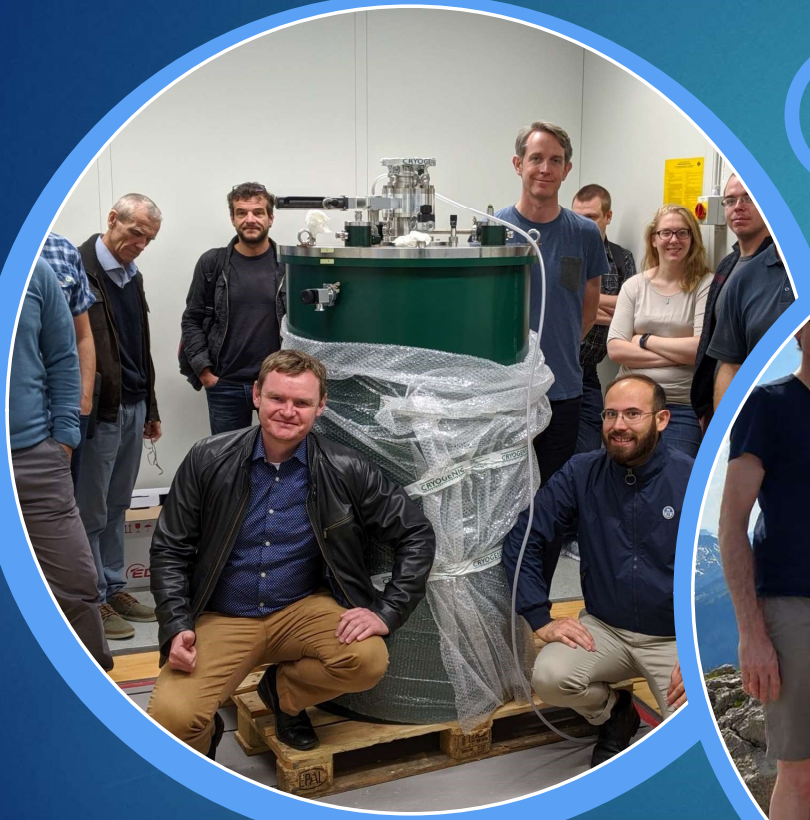
Plans for the future

- At the present: proof-of-concept of technology, operational prototype
- Development of user manuals; Fine-tuning the procedures
- Cooperation with research groups – all kind of samples
- Patent

Thank you from the PETER collective!
www.peter-instruments.eu



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